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THE OCCURRENCE OF *TRYPANOPLASMA* AS AN ECTOPARASITE

By Olive Swezy

The question of the adaptation of a protozoan parasite, either in its morphological modifications or in its physiological reactions, to its habitat is one that presents many interesting and at the same time puzzling aspects. In the group of so-called facultative parasites, largely composed of flagellates and amoebas, some forms seem to present such adaptive modifications, particularly among the flagellates. This is shown in the development of certain structures, such as undulating membranes, and more especially of the neuromotor system which reaches its greatest development among the parasitic flagellates.

On the other hand, structural modifications are almost totally lacking in the amoebas, either as obligatory or facultative parasites. Undoubtedly physiological adaptations are present but are such as leave no record in structural organization.

Such modifications or the apparent lack of them may be found in both the true entozoic parasites, as well as those that are merely commensal in the intestinal tract of the host. Thus *Entamoeba histolytica* presents no distinct structural modifications indicative of its dangerous parasitic career. The flagellate *Bodo* is apparently a harmless commensal in the intestinal tract of frogs, etc., and differs in no wise from the free-living representatives of the genus. The mode of adaptive response in both cases is physiological and not structural.

However, when this comparison is extended to protozoans infesting other parts of the body a different state of affairs is found, as most if not all, these parasites are forms which have no representatives among free-living species. This is true of the large group of Sporozoa and of the haemoflagellates as well, with a single exception which will be pointed out below. This fact is probably accounted for by the higher degree of specialization which an organism must attain before it finds itself at home in an environment such as the blood, which differs so greatly from the habitat from which it originally came.

The degree of difference between conditions in the intestinal tract of a frog and of the water in which it lives is not so great as that between the intestinal tract and the highly oxygenized blood-stream.

The single exception to this among the true haemoflagellates is found in the genus *Trypanoplasma.* This genus contains a number of species which may be divided into three groups according to their habitat. The first of these are parasitic in the blood of fresh water fishes, the second in the digestive tract of marine fishes and the third in various invertebrates. Minchin (1912) doubts the validity of placing all the flagellates that have been thus described in a single genus. Habitat alone, however, cannot be used as a generic distinction.

This small flagellate to which had earlier been given the name *Trypanoplasma carassii* (Swezy, 1915), is found as an ectoparasite on gold-fish. No evidences are forthcoming to indicate that it is truly parasitic in its habits, but it is rather a commensal, living in the mucus that is ordinarily present on the surface of the fish. *Costia necatrix* is usually found associated with it. Examinations were frequently made of the water in the aquarium containing the gold-fish but no flagellates were found in it. To secure them the body of the fish must be lightly scraped with a scalpel or other instrument.

The body of the flagellate is roughly triangular in shape with the broader end anterior (pl. M, fig. 3). Its length varies from 5 to 12μ and its width at the anterior end about 3 to 7μ. In many cases the body is long and slender, more nearly approaching the trypanosome-like form of the blood-inhabiting species (pl. VI, fig. 2).

The neuromotor system consists of a vesicular nucleus, parabasal body, blepharoplast, with their connecting rhizoplasts, and two flagella (pl. VI, fig. 3). The nucleus is situated near the middle region of the body or slightly anterior, and usually at one side. It is relatively large and vesicular in type, with a large central karyosome bordered by a distinctly light area. In the more slender, attenuate forms the vesicular structure is often obscured, the entire nucleus taking a dark stain. On the opposite side of the body, at the same level or slightly anterior to it, is the parabasal body. This is usually rounded in shape but may be slightly elongated or even somewhat irregular in outline. It stains a deep black with iron haematoxylin and shows no differentiated structure. It is connected with the nucleus by a slender, deeply staining rhizoplast.

In front of this structure and near the antero-lateral margin of the body, is the blepharoplast. This is composed of a single granule from which arise the two flagella (fig. 3). It is connected with the parabasal body and apparently also with the nucleus itself by slender, deeply staining rhizoplasts. In some cases the rhizoplast connecting the nucleus and blepharoplast cannot be distinguished (fig. 1). In most of the flagellates observed, however, the three rhizoplasts are present, i.e. from the nucleus to the parabasal body and also to the blepharoplast and from the blepharoplast to the parabasal body (fig. 3), closely linking together these three parts of the neuromotor system.

One of the two flagella is directed anteriorly, the other posteriorly. The former may have a length two or even three times that of the body. The posteriorly directed flagellum is usually much shorter, sometimes not exceeding the body in length. It is attached to the surface by a thin membrane which may show an undulating line (fig. 3) or may present a nearly smooth contour (fig. 2).

A comparison of *Trypanoplasma carassii* with the blood inhabiting species of the genus shows no important differences. In *T. borreli* as figured by Keysselitz (1905) the body has the same general form, narrower posteriorly, but, unlike *T. carassii*, shows a strongly marked curvature or sickle-shaped outline. It is also much larger than the latter species, its length varying from 10 to 40μ. The parabasal body is elongate, extending from near the blepharoplast backward along the lateral margin of the body with a length that may sometimes equal one-third or more of the total length of the body (fig. 4).

Intestinal species do not differ materially from the blood-inhabiting forms. *Trypanoplasma congeri*, from the stomach of the conger eel (Martin, 1910), has a slender, elongate form (fig. 5) with the same type of parabasal body and nucleus found in *T. borreli*. The nucleus shows a tendency to assume an oval shape in some individuals.

It is thus evident that this flagellate with an ectoparasitic habit, presents no specific structural differences distinguishing it from other species of the same genus inhabiting the blood-stream. Its occurrence is noteworthy as being the only example of the haemoflagellates which has thus far been described from a habitat outside the body of a living animal. The genus probably represents a transition stage between the strictly intestinal group of flagellates and the haemoflagellates or blood-inhabiting forms, with this species still retaining the ability to live outside of its normal host as do other of the ordinary intestinal flagellates. No trypanoplasmas were found in the intestinal tract or blood of the gold-fish from which these flagellates were taken. This precludes the possibility of an accidental infection of these fish from the faeces.

Trypanoplasma carassii is much smaller in size than either of the other two species and is one of the smallest that has been described for the genus. In the structure and arrangement of the nucleus and parabasal body it presents some striking resemblances to *Prowazekia* to which genus it could properly be assigned were it not for the presence of the undulating membrane. These resemblances suggest an evolutionary development of this genus from *Prowazekia* or a similar form.

The interrelations of the various parts of the neuromotor system in *Trypanoplasma* have not been figured by previous investigators. It is probable that the same connecting rhizoplasts are present in all the species of this genus, linking together the blepharoplast, nucleus and parabasal body.

The facts concerning the life cycle of *Trypanoplasma* are still obscure and await further investigation. Even its methods of division have not been thus far satisfactorily accounted for. Nor can any light be thrown on these questions from present work on this species from gold-fish. Division forms were not observed. Its minute size renders it a difficult object to work with satisfactorily.

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EXPLANATION OF PLATE

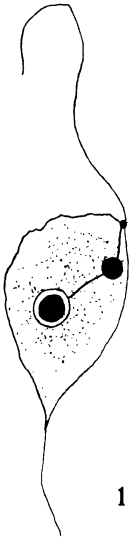
Fig. 1. *Trypanoplasma carassii* Swezy. Ordinary trophozoite showing the typica outline with single blepharoplast, flagella, undulating membrane, parabasal body and and nucleus. The rhizoplast connecting the blepharoplast and nucleus could not be detected. ×2235.

Fig. 2. Slender elongate form of the same. ×2235.

Fig. 3. Typical form of trophozoite with the rhizoplast connecting the nucleus and the blepharoplast. ×2235.

Fig. 4. *Trypanoplasma borreli* Laveran and Mesnil. After Keysselitz (1906, fig. 13). Normal trophozoite showing the elongate parabasal body. Rhizoplast are lacking. ×2235.

Fig. 5. *Trypanoplasma congeri* Martin. After Martin (1910, fig. 1). Normal active trophozoite. A line of faintly marked cytoplasmic granules follows the base of the undulating membrane. ×2235.



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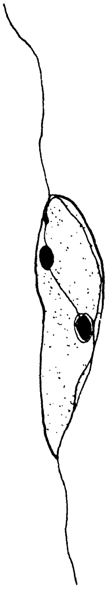

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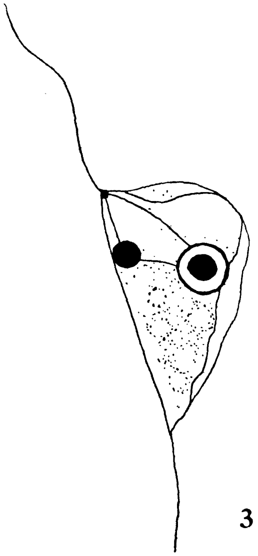

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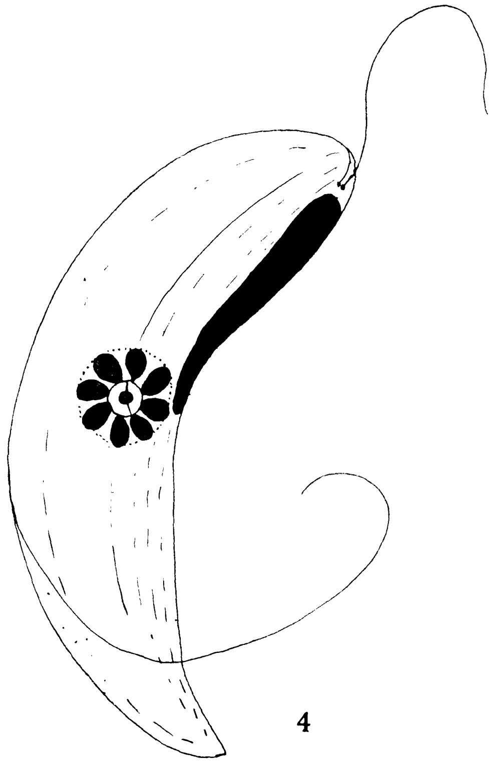

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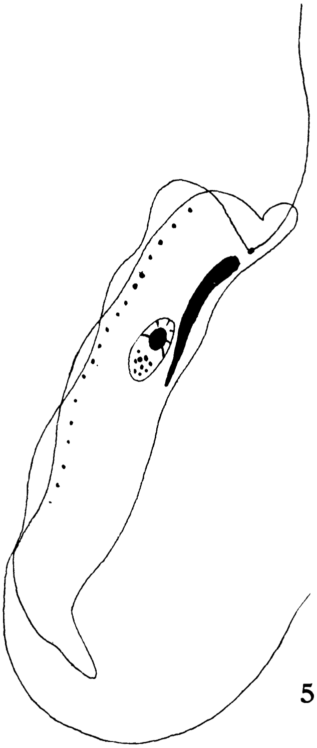

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PLATE VI

SWEZY